improved somewhat as to her general symptoms for the next three or four days and the pus considerably diminished. On the fourth day following the delivery the pus again appeared in large quantities in the urine, the temperature again shot up to 103°, and she began to develop still more alarming symptoms of septic poisoning. On July 14th she complained of pain in the left renal region, and by palpation the lower pole of the kidney could be easily detected and was decidedly tender on pressure. The right kidney could also be palpated, but was not tender. The patient was carefully watched, but as an absolute milk diet accomplished nothing, in sheer desperation operation was decided upon, and on July 22d the left kidney was exposed and decapsulated; it was greatly enlarged and intensely congested, but easily decapsulated. The right kidney was then exposed and found considerably disorganized, its pelvis being dilated to four or five times its normal size and contained a large quantity of purulent fluid. This kidney was decapsulated and drainage tubes introduced into the renal pelvis through the parenchyma. The operation lasted thirty-five minutes. The patient stood the operative shock well, but gradually sank and died early the next morning. No autopsy could be obtained, but the right kidney was removed and presented all the macroscopic and microscopic characteristics of advanced pyelonephritis.

TUMOR OF THE CAUDA EQUINA.

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D. S., aged forty-two years; single; physician; enjoyed good health, with the exception of malaria, until 1894, when he suffered during three weeks with an attack of dysentery.

Three years ago, in May, 1901, the patient noticed the first symptoms of his disease. On defecation he felt a slight pain radiating from the region of the incisura ischiadica major to the posterior side of both thighs and knees. After a few weeks these pains in both legs started independent of the act of defecation at four o'clock each morning, when the patient awakened with a pain, which, increasing in intensity, soon became excruciating. These paroxysms lasted for about two hours, and did not return during the day. The patient thought that this sciatica was due to nervous overexertion, and was confirmed in his view by the fact that after taking a vacation he was entirely without pain during four weeks. After this short intermission the pain returned and persisted in both sciatic nerves. During some months the suffering was bearable; once or twice a year there would be an acute attack lasting for about six weeks, during which the pain was agonizing. The severity of these attacks could always be mitigated by hydrotherapy and by the administration of large doses of aspirin.

About a year after the disease began rectal crises appeared with extremely painful tenesmus. These crises lasted for about two or three days, and then disappeared for several weeks; during the exacerbations they became more frequent and returned daily without relation to defecation.

During the last few months the process began to ascend, involving the nerve along the crista ilii. The patient described his pain as manifesting itself between the sacroiliacal synchondrosis and the knee on both sides. Only exceptionally did the pain appear below the knee or in the internal region of the thigh.

In the beginning the pain was lancinating in character, with intervals of entire freedom; after one year's duration the pain became of a dull and boring character, with acute exacerbations.

The patient was seen in September, 1904, in one of his attacks; he was well nourished; no anæmia; the differential blood count showing normal conditions; no myelocytes. Slight dulness over both apices, with increased fremitus. On auscultation crackling rales on both sides; no sputum; heart dulness normal; no murmurs; slight arteriosclerosis of the peripheral vessels; liver and spleen normal. Urine without albumin or sugar; without Bence-Jones body.

Pupils equal, reacting to light and accommodation; eye-grounds normal; movements of eyeball normal; no paresis of any muscles; no anæsthesia; no analgesia; reflexes normal, except slightly exaggerated knee-jerks and Achilles reflexes; no foot clonus; no Babinsky; skin reflexes normal.

The only symptom which could be recognized was an excessive tenderness of both sciatic nerves and the two sacroiliac synchondroses. Over the sacrum a point corresponding to about the third sacral vertebra 3 cm. to the left of the median line was extremely tender on pressure, and a circumscribed swelling corresponding to this point of tenderness could be made out. Rectal examination failed to show any pathological changes. Palpation of the sacrum from the rectum did not show any swelling, nor did it elicit any pain.

During the last few months the nerves had become so tender that patient could not lie on his back or abdomen, but for relief was obliged to rest in a kneeling position. In order to sleep the patient knelt on cushions and reposed his head on the bed.

To allay his suffering injections of cocaine were given in the sciatic nerves, which afforded almost complete relief for several hours. The tenesmus was relieved by rectal injections of one-fiftieth of atropine.

In the beginning of October, 1904, œdema of the ankles extending to the knee was noticed, which persisted with but little change for about four weeks. Then the œdema increased very rapidly, extending to the thigh and then to the scrotum. At the same time evening temperatures of 102° to 103°, that had not been present before, were observed, and the urine began to contain albumin, which rapidly increased in amount until urine with a high specific gravity, large amount of albumin, and very few morphological elements were passed. The daily amount varied between 800 and 1000 c.c., the specific gravity between 1030 and 1035.

Palpation of abdomen and back and of the vertebral column did not reveal any lesions.

The diagnosis had to be deduced from the above-described symptoms and to be based upon the double sciatica of three and one-half years' standing, which was evidently due to either a compression by some new-growth or an inflammatory process communicated to the nerve-sheath. The localization of such a lesion was to be sought in a place where a single focus could involve the roots of the two sciatic nerves at the same time. A localization fulfilling these conditions was supposable in three places: 1. In the conus of the medulla. 2. In the cauda equina. 3. In the sacrum; the process could be caused by a change in the bone, or in the periosteum. The differentiation between lesions of the conus and those of the cauda has been made the subject of extensive study in the last few years, and our knowledge has been most admirably reviewed by Müller.[1] He gives a *résumé* of the most essential points of differentiation in the following table, in which, in a special column, I shall discuss the application to the present case. (See Table I.)

We see by the discussion of the existing symptoms that all the points which allow a differentiation between these two localizations pointed to a lesion of the cauda and permitted the exclusion of a lesion of the conus. We would like to put special stress upon the isolated involvement of the rectum. A lesion occurring in the conus would necessarily involve the bladder centre as well as the rectal centre, the two centres lying so close together that an isolated lesion of one centre only can hardly be conceived.

The differentiation and localization between the caudal lesion and lesion within the bone was an extremely difficult one, as the direct symptoms did not warrant a positive opinion.

In case of a caudal lesion we might have to deal with a tumor or pachymeningitis compressing the posterior roots. In either case we should have expected some involvement of the motor roots, or some anæsthesia showing that we had to deal with an advancing process. On the other hand, pachymeningitis is extremely rare in these regions. A tumor growing within the spinal canal would, as we thought, give rise to symptoms of progressing compression. In this case the symptoms, which practically had not increased since the beginning of the disease, did not show the advance by "étapes," which is so characteristic of the new-growths within the spinal canal. The same consideration has caused Lacquer[6] to diagnose a tumor situated outside of the dura mater. We could not think at this time of a new-growth having made symptoms for three and a half years without producing any motor paralysis. The probabilities seemed to point to secondary inflammation due to a change either in the bone or in the periosteum.

The nature of the pathological process seemed to be indicated by the tuberculous changes in the lungs; a slowly progressing inflammation of tuberculous nature seemed to have involved the nerves or have lead to formation of cicatricial tissue, which in shrinking caused the compression of the sciatic nerves. This view seemed to be confirmed by the occurrence of œdema, which was not explained by any lesion of the heart or the kidneys. It seemed that an obstruction of the vena cava could best explain the œdema which was slowly advancing from the periphery to the centre, and was only present in the area supplied by this vessel. A compression by cicatricial tissue seemed to be the most probable supposition; the absence of any collateral circulation going to show that this compression was not a complete one.

Because of the rapid increase in the œdema and the intolerable pain, the advisability of an operation to relieve the pressure symptoms was considered. Dr. Stillman, who saw the case with me, shared my opinion, and so we decided to perform a laparotomy, to inspect the vessels of the abdomen, and then to make an incision into the point of maximum tenderness over the sacrum, and to proceed according to the findings. The operation performed by Dr. Stillman revealed a normal vena cava without any signs of obstruction or compression.

The second incision, corresponding to the point of greatest tenderness over the sacrum, showed a dilated vein disappearing into that bone. The roof of the sacrospinal canal was removed, and in the opening so formed a round, deeply injected tumor, banana-like in form, about 6 cm. long and 2 cm. wide, was discovered beneath the dura mater, which formed the floor of the opening. On incision of the dura the tumor was easily removed, and proved on microscopic examination by Dr. Ophuls to be a gliosarcoma of relatively benign character.

The wound was drained. Six hours after operation the patient was perfectly conscious without any pain. On the following day he felt quite well; all the pain and soreness had disappeared, and he rested comfortably on his back. On the third day the patient had some fever and became delirious; in the evening he showed signs of a hypostatic pneumonia. Besides this, the symptoms of incipient meningitis, shown by difference of the pupils, Kernig's sign and general hyperæsthesia, were present. On the fourth day he became comatose and died in the evening.

Dr. Ophuls, to whom I am greatly indebted for communicating his notes, performed the autopsy, revealing general septicæmia, with the presence of Friedländer bacilli in all of the organs, slight tuberculosis of both apices, pneumonia and purulent meningitis. The examination of the wound showed that the new-growth had been completely removed, and that there was no trace of tumor tissue left. The nerves of the cauda equina were perfectly normal and showed no results of the long-standing compression.

The operation showed that the symptoms of this case were due to the presence of an intraspinal tumor. Apparently the interval between the occurrence of irritation of the posterior roots and the development of further signs of compression in this case is the longest on record. Three and a half years had elapsed between the double sciatica and the time of operation, at which no other symptoms corroborating an intraspinal lesion could be found. Of course, with so large a tumor such an absence of compression symptoms is only possible within the cauda equina, where within a relatively large spinal canal only a few nerves are found.

The œdema could not be accounted for by the findings of the postmortem, and had to be considered an idiopathic œdema, one which cannot be explained by any heart or kidney lesion, or by mechanical conditions. The pathogenesis of it is very obscure; however, we recognize two varieties of this lesion of the peripheral vessels. The first seems to be due to an anatomical change, as demonstrated by the numerous cases, which follow infectious diseases, especially scarlatina; the second is caused by vasomotor disturbance, and constitutes the group described by Osler as angioneurotic œdema. Our case seems to belong to the second variety. Whether the connection is direct or due to some reflect disturbance of the vasomotor centre is hard to say in the absence of any analogous case.[3]

If we compare this observation with the cases communicated by other observers we see that the clinical picture of tumor of the cauda equina is variable, depending upon the site of the tumor. I shall try, by analyzing a few cases, which I am able to find reported in the literature, to develop the clinical appearance of these different forms.

The first case published in modern literature is a tumor of the filum terminale described by Dr. Lachmann.[9] The patient presented some paræsthesia in the legs, an ischuria paradoxa and incontinence of rectum; no anæsthesia; no paralysis. The prominent feature of the case was paralysis of bladder and rectum; no radiating pain; no signs of any posterior nerve-root compression. The presence of a tumor was not diagnosed, but discovered at the postmortem examination.

The second case, which almost resembled our present case, is described by Lacquer.[6] A young man, aged nineteen years, had been suffering from pain in the back and sacrum for the last two years; at night these pains became more acute and irradiated to the knee. At the time of observation, one and one-half years after the onset, the patient did not present any objective symptoms.

Following the first examination an intermission of about two to four months intervened. A new exacerbation resulted in excruciating pains in the legs and pain during urination and defecation. Slight paresis of bladder; paresis of quadriceps muscles; knee-jerk lost on right side, feeble on left; sacrum tender under pressure on both sides. The diagnosis made was that of extradural tumor compressing the cauda equina.

At operation a lymphangioma compressing the cauda equina and situated outside of the dural sac was found and successfully removed. The patient recovered completely.

The third case was described by Valentini.[2] A boy, aged eleven years, suffered for seven months from severe pain in the sacrum. About nine weeks before admission the pain became more accentuated, and three days after his legs became paralyzed; a week following he lost control of the bladder. Upon examination a flabby protrusion could be felt in the region of the third lumbar vertebra. The muscles of the legs were entirely paralyzed, with the exception of the tibialis anticus. Biceps, semimembranosus and semitendinosus weak; quadriceps normal; abductors normal; glutei paralyzed. In all the paralyzed muscles reaction of degeneration. Anæsthesia of nates, perineum, scrotum, and penis. Testicles sensitive, only posterior part of thigh anæsthetic, below knee posterior and lateral anæsthetic; foot completely anæsthetic.

A puncture of the swelling over the vertebra yielded a small piece of tumor, which proved to be a sarcoma. The patient was dismissed.

Fourth case, described by Vollhard.[8] Patient has been aware of the fact for four years that his micturition has been more frequent and difficult. In order to completely empty his bladder, which was easily felt, he had to press with his hands upon his abdomen; in defecating the patient was obliged to use his abdominal muscles to a large extent. Sensation of deep pressure over sacrum; atrophy of the muscles of the left foot and leg. During the whole course of the disease patient never had any pain.

Nervous System. No ataxia; knee-jerk and cremaster reflex increased; Achilles absent on left, present on right; plantar reflex very weak on either side; normal plantar reflex of toes absent; paresis in several muscles innervated by the left sciatic nerve; no anæsthesia. Retention of urine alternating with paradoxical ischuria. Patient died of septic pyelonephritis before operation, which was planned, but could not be done. On postmortem a tumor of the filum terminale was found which corresponded in situation to the diagnosed tumor.

Fifth case; W. Thorburn.[3] Typical anæsthesia of legs, posterior perineum, and penis. The disease began with extreme pain, paralysis of bladder and rectum; at postmortem a tumor the size of a hemp-seed was found in one of the nerve roots of the cauda.

Sixth case, described by Schultze.[4] Disease originated with pain in both sciatic nerves, which continued for two and a half years without any objective symptoms. At this time paresis in the muscles innervated by the right peroneal nerve set in. Some time afterward crises of the bladder and constipation resulted. Seven years after the beginning anæsthesia in both feet was present. The next year cystitis following paresis of the bladder was noticed; nine years after beginning paralysis of all the muscles of the leg below the knee with the exception of the tibialis anticus and extensor hallucis longus was noticed, showing the reaction of degeneration. Achilles reflex absent on the left side; paresis of biceps and glutei.

Twelve years after the beginning both biceps femoris muscles showed reaction of degeneration; paresis of the bladder and rectum; knee-jerk could be obtained only by Jenderassik's method; anæsthesia in the whole sacral plexus, perineum, scrotum, and penis. A year afterward knee-jerk lost. Diagnosis was made on tumor of cauda, and operation revealed a tumor extending from the second vertebra to the sacrum. It was too large to be entirely extirpated, and the patient died a few days later. On postmortem it was demonstrated that the tumor had invaded the whole bony sacrum.

The seventh case was described by Gowers.[5] A man aged twenty-eight years, whose symptoms commenced nine months before death and consisted of severe pain in both legs, and progressive weakness; the power of standing was lost about four months after the onset. Very little power in the flexors of the hip; extensors of hip slightly paretic; knee-jerk absent; all muscles of the leg considerably atrophied; extreme atrophy of the muscles below the knee; no reaction of degeneration. Tactile sensibility was impaired in each foot and lower leg, more so in the right, and chiefly in the region supplied by the sacral plexus; sensibility to pain not affected. The bladder was involved early and symptoms of pyelonephritis already existed. The kidney disease was the immediate cause of death. At postmortem a fibrosarcoma of the cauda involving many nerve roots was found.

Case eight, described by Selberg.[7] Patient, aged twenty-four years, had suffered a trauma in the region of the sacrum. Six months afterward she began to complain of backache, which prevented her from sitting down for any length of time; shortly afterward she began to claudicate. The clinical picture was completed by signs of retention of urine.

On examination the muscles innervated by the left sciatic nerve were found to be paretic; on both sides absence of knee-jerk; extreme tenderness of sacrum. The diagnosis was made on a tumor compressing the cauda equina in the height of the third, fourth, and fifth lumbar nerves.

Operation showed a very large tumor, which could not be entirely extirpated; patient died soon after operation. Postmortem revealed tumor reaching up to the twelfth dorsal vertebra, consisting of sarcomatous tissue.

To allow a comparison between the different cases we have tried in the accompanying tables to give a short recapitulation of the principal symptoms and their relationship. (See Table II.)

It has been attempted to establish from the existing cases the symptomatology of caudal tumors. It is very obvious that, like tumors in other portions of the spinal column, those of the cauda equina do not present one invariable set of symptoms, but they must be classified in various groups. The clinical appearance will vary with the nature of the tumor, with its size, rapidity of growth, and location. If we consider the above-described cases we see that they represent three different clinical entities. A first group contains the cases of Lachmann and Vollhard; the tumor originated here from the filum terminale. In both cases we find absence of the initial neuralgic pain, which otherwise is so indicative of caudal lesion. They began with bladder symptoms, which, in the cases of Lachmann, constitute the principal symptom during the whole progress of the disease, and are only completed by paræsthesias within the sciatic nerve areas.

In Vollhard's case the clinical history is completed by paralysis of several muscles innervated by the sciatic nerve. Characteristic of these cases is the disturbance of bladder combined with the symptom indicating a lesion of the sciatic nerve, and an absence of neuralgic pain, which is best explained by the theory suggested by Vollhard. The tumor originating from the filum terminale and situated at the anterior side of the conus will first compress the motor roots against the bone, while the conus would protect the sensory roots from any direct pressure.

A second group constitutes cases originating in the bone and involving secondarily the cauda equina (cases of Valentini and Selberg). In these the development is comparatively rapid (nine and eighteen months), and the clinical history contains all the symptoms supposed to be characteristic of caudal lesion.

They begin with neuralgic pain in the sacrum and both sciatic nerves; they show anæsthesia in the region innervated by the sacral plexus, paralysis of muscles supplied by the sciatic nerves and disturbance in the function of bladder and rectum. The clinical evidence of a caudal lesion so completely present in these cases, combined with the local findings on the vertebral column, allow of relatively easy diagnosis. The rapid development, the completeness of the caudal symptoms are the characteristic features of these cases.

A third group comprises the cases of Gowers, Schultze, Lacquer and the case described in this paper. Gowers' case, which is not fully described, cannot be used for the drawing of the clinical picture; but the other three cases present such a uniform and concordant clinical history that the diagnosis in analogous cases should be made. All three cases begin with a double sciatica and dull pain in the sacrum. In all cases the pain is described as an intolerable one, and in the cases of Lacquer and Schmoll is characterized by nightly exacerbations; a fact which, to my mind, can be best explained by the extreme vascularity of these tumors; the lying position produces passive congestion of the tumor, which increases the compression of the sensory roots. This double sciatica, as a rule, remains an isolated symptom from one, two, to three years, until the bladder and rectum symptoms declare themselves either in the form of slight paralysis of these organs or in the form of neuralgiaform crises. At the same time or later on anæsthesias and paralysis of the muscles innervated by the sacral plexus may appear.

These three clinical forms correspond to three different localizations and modes of development of the cauda tumor. The first group presenting bladder and rectum lesions, paralysis and anæsthesia in the sciatic nerve, corresponds to a slowly growing central tumor just below the conus. In these cases the differentiation from tumors of the conus terminales will be especially a different one, and can only be made by the development of the different symptoms.

The second group comprises the tumors of great malignancy, mostly originating from the bone; they present the complete classical picture of the cauda lesion, and their clinical appearance will only vary according to the situation and development of the tumor.

The third group constitutes the cases of slowly growing tumors developing within the roots of the cauda. Characteristic of these cases is the double sciatica eventually combined with anæsthesias, or paralyses within the region of this nerve, and symptoms of bladder

TABLE I.

Points of differentiation.	Conus.	Cauda.	Present case.
Development of case.	Mostly in a few days: myelitis.	Very slow in case of tumor, acute in cases of trauma.	Development has been very slow.
Symptoms of irritation of sensory roots.	Mostly absent.	Of very great intensity, radiating in sciatic and bladder region.	Radiating pain in the sciatic nerves and rectum are pronounced symptoms.
Symptoms of sensory paralysis.	Occur early in the clinical picture; often in the form of dissociated anæsthesia.	Occur late in the clinical history, and then in the form of complete anæsthesia.	No anæsthesia.
Symptoms of motor paralysis.	Originate early; atrophy, reaction of degeneration.	Occur only after a long period; reaction of degeneration occurs slower.	No motor paralysis: speaks for caudal lesion.
Relation of sensory to motor paralysis.	Motor paralysis paramount in clinical symptoms, anæsthesia not pronounced in clinical picture.	Preponderance of sensory irritation.	No motor paralysis; very severe sensory irritation indicating caudal lesion.
Disturbance of bladder and rectum.	Bladder and rectum always paretic or paralyzed; genital reflexes sometimes present.	Disturbance of these organs resemble caudal lesion.	Isolated crises of rectum without bladder symptoms practically exclude conus lesion.

TABLE II.—TUMORS OF THE CAUDA EQUINA.

Case.	Duration.	Symptoms of sensory irritation.	Anæsthesias.	Symptoms of motor irritation.	Paralysis.	The relation between sensory and motor symptoms.	Disturbance of bladder and rectum.	Findings at post-mortem.
Lachmann,	About 6 months	None.	Slight paræsthesias in legs.	None	None.	....	Ischuria paradoxa and incontinentia recti.	Glioma of the filum terminale adjoining the cord.
Lacquer,	1½ years	Excruciating pain in the sacrum irradiating to the knee, worse at night with entirely free intervals.	None.	None	Slight paralysis of quadriceps; knee-jerks lost on left side.	Motor paralysis about two years after sensory symptoms.	Slight paralysis of bladder.	Lymphangioma extirpated; patient got well.
Valentini,	7 months	Severe pain in back, especially sacrum.	Anæsthesia of both legs corresponding to the two sciatic nerves.	None	Paralysis of the calf-muscles and left out-flexions of tibia weak.	5 months.	Paralysis of bladder.	Sarcoma of the lumbar vertebra.
Vollhard,	4 years	No pain.	None.	None	Paresis of several muscles innervated by the left sciatic.	....	Started in with paresis of bladder and rectum.	Tumor of the conus terminalis. Died before planned operation.
Schultze,	18 years	Pain in both sciatic nerves.	Complete anæsthesia in the whole plexus sacralis.	None	Paralysis of the whole leg.	1½ years.	Paresis of bladder and rectum.	Tumor of the second lumbar vertebra, extending down to the sacrum. Died three days after operation.
Gowers,	9 months	Pain in both nerves.	Anæsthesia in places innervated by the sacral plexus.	None	Paralysis of both legs.	....	Paralysis of bladder and rectum.	At postmortem tumor just below the conus.
Thorburn,	9 months	Pain very severe.	Typical anæsthesia of nerves and legs.	None	Paralysis of muscles innervated by sciatic nerve.	....	Paralysis of bladder and rectum.	Small tumor involving some nerve roots.
Selberg,	18 months	Backache.	Typical anæsthesia.	None	Paralysis of muscles innervated by ischiatic.	About 3 years.	Paralysis of bladder and rectum.	Tumor of the twelfth dorsal reacting to the sacrum.
Schmoll,	8½ years	Excruciating pain, irradiating down to the sacrum; worse at night.	No anæsthesia.	None	None.	....	Crises of rectum.	Gliosarcoma comprising three-ninths sacral nerves first three days after operation.

or rectum lesion. On account of their easy accessibility, their superficial position, these cases constitute the most favorable field for surgery of the central nervous system.

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THE SPIROCHÆTÆ FOUND IN SYPHILIS.[1]

A REPORT OF THIRTY-FOUR CASES.

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ANY discovery which seems to bring us nearer to the specific cause of a disease is hailed with great enthusiasm. Usually such discoveries are based upon the study of but few cases, and, in the majority, the results are not supported by extended observations. Recently, it has been maintained that the cause of syphilis has been discovered, and it appears, from the number of successful results obtained by others than the original discoverers, that something definite has been achieved.

Schaudinn and Hoffmann[2] call attention to a very delicate organism which they found constantly in syphilitic lesions, and which they term the spirochæta pallida. Occurring with this parasite was another, a larger, darker organism, the spirochæta refringens. They found these parasites in the juice of glands, chancres, and flat condylomata. Material from these sources was examined fresh and in stained preparations. The spirochæta pallida is described as being extremely difficult to see in the fresh state and very refractory to stains. It varies in length from 4 to 14μ, the width from an immeasurable thickness to five-tenths of a micron, and the number of bends or curves from 3 to 12. It is motile,

[1] Read by title at the Pathological Society of Philadelphia, October 26, 1905.

[2] Arbeiten aus dem Kaiserlichen Gesundheitsamte, Berlin, April 10, Heft 2, p. 527.